

PATENT SPECIFICATION



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COMPLETE SPECIFICATION

Improvements in or relating to Gear Shifting Mechanism

We, AUTOMATIC SHIFTERS, INCORPORATED, of 369, Oak Lane, Richmond, Virginia, United States of America, a corporation organized under the laws of the State of Virginia, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:

This invention relates to gear shifting mechanism particularly for motor vehicles in which the transmission has a transmission operating member movable in opposite directions from a neutral position into different transmission setting (i.e. gear change) positions by means of a servo-motor.

Mechanisms of this kind have been proposed in conventional transmissions having means intended to preserve to the operator the "feel" of the shift, but these means have involved complicated devices to impose a drag on the movement of the manual control member of the gear shift mechanism or air cylinders or diaphragms in addition to those required for the actual shifting.

It has also been proposed in connection with a manually-controlled servo and braking apparatus for epicyclic change speed gears to provide a main operating piston movable in one direction from one end of a cylinder and a secondary piston connected to a manually-operated control member, the arrangement being such that the fluid pressure acting on the main piston reacts against the secondary piston to permit the operator to "feel" the power applied by the servo apparatus.

The principal object of the present invention is to provide a means for accomplishing the desired results with minimum complication and through the use of links and levers not liable to deteriorate or get out of order.

Another object of this invention is the provision of a power actuated gear shifter in which the "feel" in the control handle can be readily adjusted, making the movement of the handle more or less easy as may be required to suit different individuals.

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According to the present invention the mechanism comprises a manually movable control member or handle accessible to the operator and connected to control the energisation of the servo-motor, a transmission operating lever to which force is applied by both the manually movable member and the servo-motor to effect gear shift, a floating device connected to the operating lever and displaceable relatively thereto by means of the manually movable member, and means whereby this displacement is attended by an energisation of the servo-motor in the direction to cause the operating lever to follow the displacement of the floating device until such parts resume their normal relationship, the arrangement being such that a small and substantially proportional force as compared with that of the servo-motor reacts against said manually movable member simultaneously with the application of force by the servo-motor, whereby the operator will feel a resistance to movement of the manually movable member substantially proportional to the resistance encountered by the operating lever.

The power actuated gear shift mechanism of our Patent No. 509,164 also includes means whereby a small and substantially proportional force as compared with that of the servo-motor reacts against a manually movable control member simultaneously with the application of force by the servo-motor to cause the driver to feel a resistance to movement of the control member. The mechanism according to Patent No. 509,164 employs a fluid pressure responsive device which is primarily intended to provide the operator with "feel," which device incidentally provides a small force in addition to that of the servo-motor tending to swing the transmission operating lever as the fluid pressure in the device reacts in opposite directions, the reaction in one direction being taken up by the operator's hand while the reaction in the opposite direction tends to move the said lever. In this prior arrangement force is not applied by the manually moved member although the force applied to such member determines

the force which will be applied by fluid pressure to the lever. The mechanism of the present invention is, therefore, distinguished from that of Patent No. 509,164 in that both the manually movable control member and the servo-motor apply force to the transmission operating lever, the manually movable member applying directly to the lever the force applied by the hand of the operator to said member.

The invention will now be described with the aid of the accompanying drawings forming a part of this specification, wherein like reference characters designate corresponding parts in the several views.

In the drawings:

Fig. 1 is a perspective view, partly broken away, of one of the preferred embodiments of our invention;

Figs. 2 and 3 are modifications of part of the mechanism shown in Fig. 1; and

Fig. 4 is an elevation, partly in section, of another embodiment of the invention.

Before explaining in detail the present invention, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practised or carried out in various ways.

The embodiment of the invention shown in Fig. 1 is applied to a conventional automobile transmission 10 containing two shift rails 11 and 12 which are each longitudinally slidably in either direction from a neutral position selectively to engage any one of the various ratio gears in the transmission. The invention comprises a mechanism for moving the shift rails 11 and 12 in accordance with the movement of a manually movable control member in the form of a small gear lever 13, which may be carried by a hollow bracket 14 projecting back from the instrument panel of the automobile.

The shift rails 11 and 12 are selectively acted upon by a pin 15 carried on one end of a link 16. The link can swing to either side and cause the pin 15 to engage a notch in either shift rail 11 or 12. The lateral position of the link 16 is controlled by a small cross-over motor 17 comprising a diaphragm 18 urged in one direction by a spring 19 and arranged to be moved in the opposite direction by suction applied through a tube 20. The centre of the diaphragm 18 is secured to and moves a rod 22 which carries an elongated guide 23 parallel to the shift rails 11 and 12. An upward extension 15a of the shift-rail-engaging pin 15 on the link 16 fits into the guide 23, so that as the diaphragm 18

in the cross-over motor moves to one side or the other as suction is applied or is not applied to it, the link 16 and pin 15 will be swung to one side or the other and the pin 15 will engage one shift rail or the other.

The application of suction to the cross-over motor 17 is controlled by a valve 24 by which the tube 20 leading to the motor can be selectively connected to a vent 25 or to a tube 26 connected to the intake manifold of the engine of the vehicle. The valve 24 is operated from a longitudinal lever 28 extending into the bracket 14 and having a longitudinal slot 29 through which the control lever 13 extends. Thus, the valve 24 will be operated only by lateral swinging of the longitudinal lever 28 and the lever 13, and the pin 15 will be swung to one side or the other into the notch in one shift rail 11 or the other 12 according to the position of the control lever 13.

Longitudinal movement of the shift rails 11 and 12 is effected through an operating or shift lever 30 mounted on a fulcrum 31 in the cover 32 of the transmission and having the link 16 pivoted to it at its inner end. The outer end of the shift lever 30 carries a floating device comprising a lever 33 secured to it by an adjustable pivot 34, said lever 33 having pivots 35, 36 at its respective ends. The pivot 35 at the outer end of the floating lever connects it to the piston rod 38 of a servo-motor comprising a double acting power or air cylinder 39 which is secured to the frame or other fixed part of the vehicle by a resilient or pivotal connection which will allow it to swing laterally to an extent sufficient to follow the swinging movement of the levers 30 and 33.

The greater part of the energy required to shift the gears of the transmission 10 is normally supplied by the air cylinder 39, and the remainder is supplied from the manual control lever 13 through a control link 41 connected to the pivot 36 at the inner end of the floating lever 33. The control link 41 is connected to the control lever 13 by a lever 42 or other suitable mechanism and by a link 43 slidably mounted in guides 44 within the hollow bracket 14 which carries the control lever 13. The end of the sliding link 43 which is acted upon by the control lever 13 is divided into two branches 43a and 43b at either side of the lever 13 and at different distances from its fulcrum 45. Each of the branches 43a and 43b has a notch 45 or 46 into which the control lever 13 can swing as it is moved from one side to the other, the notches being so placed that the lever can swing laterally from one to the other when it is approximately in its mid-

position longitudinally. The provision of the two notches 45 and 46 at different distances from the fulcrum 45 attains two results. It prevents the handle or lever 13 from being swung laterally except when in its mid-position, thus confining it to movement along a path having the H-shape generally characteristic of gear shift lever movements. It also provides equal movements of the control lever 13 along either leg of its H-shaped path when the shifter is used with a transmission having shift rails which move different distances, as is common when synchronizing devices are provided for second and third speeds but not for first or reverse.

The air cylinder 39 is actuated by suction coming to it through a tube 51 from the engine intake manifold, a valve body 52 fixed to the exterior of the cylinder, and tubes 53 and 54 leading from the valve to either end of the cylinder. The valve body 52 contains a spool-shaped piston 55 which is so arranged that, when it is moved in one direction from its neutral position, it connects the tube 51 from the source of suction to the tube 53 from one end of the cylinder 39 and connects the tube 54 from the other end of the cylinder to a vent 59 or 60 and, when it is moved in the other direction, reverses these connections.

The valve piston 55 is moved in accordance with the movements of the control link 41 and floating lever 33 relative to the main gear shift lever 30. This is accomplished through a small dog-leg lever 61 carried by a fulcrum 62 on the main lever 30 and having one end connected to the spindle 63 of the valve piston 55 by a link 64 and having the other end connected to either the floating lever 33 or to the control link 41 by a pin and slot or other suitable connection 65. The dog-leg lever 61 and the valve 52, 55 are preferably arranged so that the spindle 63 of the valve piston and the link 64 are in line and have their axes intersecting the axis of the fulcrum 31 of the main lever 30 when the various parts are in their neutral positions. With this arrangement, any movement of the floating lever 33 with respect to the main lever 30 will swing the dog-leg lever 61 on its fulcrum 62 and move the valve piston 55 in the direction which will cause the piston rod 38 to move so as to return the floating lever 33 to its normal position parallel with the main operating lever 30. Thus, when the control link 41 is moved in either direction, the floating lever 33 will be displaced from parallelism with the main lever 30, and the cylinder or servo-motor 39 will operate to return it to parallelism as soon as it is displaced enough to operate the

valve 52, 55. The two ends of the floating lever 33 will therefore move almost simultaneously, one end being moved manually through the control link 41 and the other being moved in step with it by the power cylinder 39, and the floating lever 33 will move the main lever 30 and cause whichever shift rail is connected to it by the swinging link 16 to be slid longitudinally.

The force exerted by the floating lever 33 at the outer end of the main lever 30 will be equal to the sum of the forces applied to the floating lever 33 by the piston rod 38 and the control link 41. Since these two last-mentioned forces are obviously always proportional to each other, the force in the control link 41 will always be proportional to their sum and therefore to the resistance offered to the movement of the main lever 30. Thus the operator will feel the varying resistance to shifting offered by the transmission and will be able to shift as well as with a conventional shift lever. He will feel the synchronizing cones come into engagement or feel the ends of the gear teeth butt against each other or slide past, and in each case he will know when to press on with the shift or to hesitate.

In case of failure of the power cylinder 39 to operate, it may be desirable to be able to shift gears manually. For instance, the engine may cease to run and provide suction for the power cylinder 39 while the vehicle is in gear, and it may be desired to place the gears in neutral while the car is being towed away to be repaired. In order to allow manual shifting, the amount of movement of the control link 41 relative to the main operating lever 30 is restricted to what is necessary to operate the valve 55. Further movement in one direction is prevented by the floating lever 33 coming into contact with one side of the main lever 30 and in the other direction is prevented by the closed end 68 on the yoke 69 on the end of the control link 41 coming into contact with the other side of the main lever 30. Thus, if the suction to the power cylinder 39 fails for any reason, the control link 41 can act directly upon the main lever 30, after a small amount of lost motion is taken up, and shifts can be made manually.

A modification of the device shown in Figure 1 is shown in Figure 2. In this form of the device, the transmission 10a, 125 the main operating or shift lever 30a, the floating lever 33a, the power cylinder 99a, the piston rod 38a, the control link 41a, the mechanism for moving the control link 41a, and the cross-over mech-

anism are generally similar to the corresponding parts in the form of the device shown in Figure 1.

The valve body 70 for controlling the application of suction to the two ends of the power cylinder 39a is slidably mounted upon the control link 41a and is connected by flexible tubes 51a, 53a, and 54a, to the source of suction and to the power cylinder 39a. Within the valve body 70 and secured to the control link 41a are four collars in two pairs 71, 72 of which the inner pair 72 regulate the application of suction to and the venting of the power cylinder 39a while the outer pair 71 serve merely as stops to limit the motion of the control link 41a relative to the valve body 70. The control link 41a extends through the valve body 70 and is secured by a pivot 36a to one end of the floating lever 33a while the valve body 70 itself is connected to the main lever 30a by a yoke 75. Thus the valve 70, 72 will be operated by relative movement of the main and floating levers 30a and 33a and will produce the same effects as the valve 52, 55 in the first form of the invention, and, upon failure of suction for the power cylinder, the stops 71 acting upon the ends of the valve body 70 will provide a direct mechanical connection between the control link 41a and the main lever 30a to permit manual shifting. While the valve body 70 has been shown integral with its ends and the collars 71 and 72 have been shown integral with the control link 41a for convenience of illustration, it will be obvious that these parts are each composed of several portions for ease of manufacture and assembly.

This form of the device is provided with means for readily adjusting the "feel", that is, for adjusting the proportion of the resistance to the shift that is felt by the operator. For this purpose the pivot 34a of the floating lever 33a upon the main lever 30a is adjustable, a plurality of closely spaced holes 77 being provided into any of which the pivot 34a can be placed. Thus the ratio of the lengths of the two arms of the floating lever 33a can be varied and the fraction 55 of the total force applied to the main lever which is supplied through the control link 41a can be varied.

A further modification of a part of the device is shown in Figure 3. In this form, the transmission 10b, the main operating lever 30b, the power cylinder 39b, the cross-over mechanism, and the mechanism for operating the control link 41b are similar to the corresponding parts of the first form of the device.

The control link 41b extends into the valve body 70b, which is secured to the main lever 30b by a pivot 80, and said link carries four collars in two pairs 71b and 72b within the valve body 70b, the four collars being similar to and performing the same functions as the four collars 71 and 72 on the control link 41a in the form of the device shown in Figure 2.

The "feel" of the shift is not provided through the control link 41b, which serves only to operate the valve members 72b or to move the main lever 30b by means of the stops 71b in the case where the power cylinder 39b is inoperative. Instead, a separate link 81 connects the lever 42b which moves the control link to a secondary lever 82 mounted on a fixed fulcrum 83 and carrying the power cylinder 39b by means of a pivot 84. Thus, when the power cylinder 39b is energized and exerts a force at its connection 85b to the main lever 30b to overcome the resistance offered by the mechanism in the transmission 10b, it will exert an equal force on its connection 84 to the secondary lever 82, and a fixed fraction of this force will be applied by the secondary lever and the link 81 to the member 42b which moves the control link 41b. The operator moving the member 42b and the control link will therefore at all times feel a force proportional to the resistance to shifting. The ratio of this force to the resistance to shifting can be varied merely by shifting the position of the anchoring pivot 84 of the power cylinder, a number of holes 85 being provided along the length of the secondary lever 82 for this purpose.

The form of the invention shown in Figure 4 is particularly adaptable to marine reverse gears and to automobile transmissions having little room at their sides, as is the case in many automobiles having frames braced by long diagonal members meeting just behind the transmission. In the case of a marine reverse gear, the gear shift device is arranged to turn a short shaft 88 projecting from the side of the transmission housing 89. In the case of an automobile transmission, the shaft 88 is arranged to move the shift rails which are within the housing 89, the shift rails being preferably at the side of the housing instead of at the top, as is conventional in so-called "rolled over" transmissions, and any suitable cross-over mechanism, such as the one shown in Figure 1, being used to selectively connect the shaft 88 to one shift rail or the other.

The shaft 88 has fixed to it a depending main operating lever 90 at the end of which a floating lever 91 is carried by a pivot 92. One arm of the floating lever 91 is connected by a pivot 93 to the piston rod 94 of a double acting power cylinder 95 of a servo-motor, which cylinder is anchored to a fixed bracket 96 by a connection which will allow a slight swinging of the cylinder. This connection comprises a stud 97 projecting from the cylinder through the bracket and carrying a nut 98 which cooperates with a shoulder 99 around the stud to clamp the bracket between the ends of a rubber washer 100.

The other arm of the floating lever 91, which is several times as long as the arm connected to the power cylinder, is connected by a pivot 102 to a valve rod 103. The valve rod is secured to a movable valve member 104 having four collars in two pairs 105, 106 slidably fitting within the bore of a valve body 107. The valve body 107 is secured to the bracket 96 in the same way as the power cylinder 95 and is provided with five ports 109, 110, 111 cooperating with the collars 105 on the movable valve member. The ports and collars are arranged in the same way as those in the valves in the embodiments shown in Figures 2 and 3. The central port 109 is connected by a flexible tube 112 to a source of suction, such as the intake manifold of an engine, and the two ports 110 at either side of the central port are connected to the ends of the power cylinder by flexible tubes 113. The end ports 111 are open to the atmosphere and serve as vents.

It may be seen from the figure that the collars 105 on the movable valve member are the same width as and are spaced slightly farther apart than the ports 110 connected to the ends of the power cylinder 95. This provides what is termed "vacuum suspension" of the piston 101 within the power cylinder 95, that is, the piston has vacuum or suction applied to both sides whenever it is at rest and quicker response to movement of the valve member 105 is provided than would be provided by other arrangements. This is so because the piston 101 is moved by the admission of air to one side while the other side is under suction, the air being so admitted almost instantaneously because it has to flow through a relatively short path from one of the vents 111.

When the movable valve member 104 is moved in one direction from its neutral position, one of the ports 110 leading to the cylinder will be placed in communication with the atmosphere and the

other, which is already slightly open to the suction from the tube 112 will be opened more. Thus the piston will move in the direction in which the valve member 104 is displaced. The necessary displacement of the valve member is produced by the floating lever 91 and a control link 114 secured by a pivot 115 near the middle of the lever. The control link or rod is manually operated by any suitable linkage, the one shown in Figure 1 for operating the control link 41 being suitable. It may be readily seen that, for every position of the control rod 114 and its pivot 115, there will be a position of the piston rod 94 and its pivot 93 at which the movable valve member 104, valve rod 103 and its pivot 102 will be in their neutral positions. It may also be seen that, if the piston rod 94 and pivot 93 are not in that position, the valve member 104 will be at that side of its neutral position which will admit air and suction to the cylinder 95 in such a way as to move the piston 101 and piston rod 94 to that position. Thus the piston 101 and piston rod 94 will follow all movements of the control rod 114.

The control rod 114 not only will control the movement of the piston 101 but will also always be subjected to a force proportional to the resistance to movement of the main shifting lever 90, thus giving the operator the "feel" of the shift. This occurs because the pivots 92 and 93 of the floating lever 91 to the main lever and to the piston rod 94 are spaced from each other a short distance, and any force exerted on the piston rod pivot 93 causes a proportional reaction on the control rod pivot 115.

In case of failure of the cylinder 95 to operate, the form of the invention shown in Figure 4 can be manually operated through the control rod 114 in the same way as the other forms shown in Figures 1 to 3. The collars 106 at the ends of the movable valve member 104 serve as stops and allow the pivot 102 between the valve rod and the floating lever to serve as a fulcrum. This occurs after the valve member 104 moves beyond its normal range of action and its movement is stopped by one of the collars 106. The control rod can then swing the floating lever 91 about the valve rod pivot 102 and move the main shift lever 90 mechanically.

Various strengths of "feel" can be provided by changing the distance between the various pivots 92, 93, 102, and 115 on the floating lever, as by shifting the control rod 114 to a pivot 117 nearer the pivot 92 of the main lever.

By similar means, the ratio of the movements of the control rod 114 and the piston rod 94 and the ratio of the movements of the control rod 114 and the 5 valve rod 103 can be varied.

While we have shown only four forms of the invention, it is obvious that it can exist in numerous other forms and can be applied to other mechanisms for shifting gears. For example, the vacuum suspension feature, while desirable, may be omitted, different types of valves may be used, and air or other gas or liquid under pressure may be employed to 10 operate the power cylinder. The latter may be replaced by other forms of motors, such as a bellows or diaphragm. It is to be understood therefore that what is included in the invention is not limited 15 by the examples described herein but only by the scope of the appended claims.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to 20 be performed, we declare that what we claim is:—

1. Gear shifting mechanism particularly for motor vehicles in which the transmission has a transmission operating 30 lever movable in opposite directions from a neutral position into different transmission setting positions by means of a servo-motor, comprising a manually movable control member accessible to the operator and connected to control the energisation of the servo-motor, said member as well as the servo-motor being capable of applying force to the transmission operating lever to effect the gear 35 shift, a floating device connected to the operating lever and displaceable relatively thereto by means of the manually controlled member, and means whereby this displacement is attended by an 40 energisation of the servo-motor in the direction to cause the operating lever to follow the displacement of the floating device until such parts resume their normal relationship, the arrangement 45 being such that a small and substantially proportional force as compared with that of the servo-motor reacts against said manual control member simultaneously 50 with the application of force by the servo-motor, whereby the operator will feel a resistance to movement of the control member substantially proportional to the 55 resistance encountered by the operating lever.
- 60 2. Gear shifting mechanism according to claim 1 in which the servo-motor is a fluid pressure motor having a pair of

chambers and pressure responsive means therebetween having motion transmitting connection with the transmission operating lever and comprising a pair of valve members relatively movable in accordance with the movement of the pressure responsive means, said valve members being 65 ported to connect either chamber to the atmosphere and the other to a source of non-atmospheric pressure when moved away from a predetermined relative position, the ports in said valve members being arranged to connect both of said 70 chambers to said source when said valve members are in said predetermined relative position.

3. Gear shifting mechanism according 80 to claim 1 or 2 in which the manually movable member has a lost-motion connection to the transmission operating lever such that in normal operation a predetermined portion of the work of shifting is done by the operator through the manually movable control member and said lever and, upon failure of the servo-motor, all of the work of shifting is 85 done by the operator through said control member and lost motion connection.

4. Gear shifting mechanism according 90 to claim 1, 2 or 3 comprising means for adjusting the position of a pivot connecting the transmission operating lever and the floating device, thereby adjusting the 95 ratio between the acting forces and adjusting the strength of the "feel".

5. Gear shifting mechanism according 100 to claim 2, 3 or 4, comprising stops associated with the valve members for limiting the relative movement of the parts thereof.

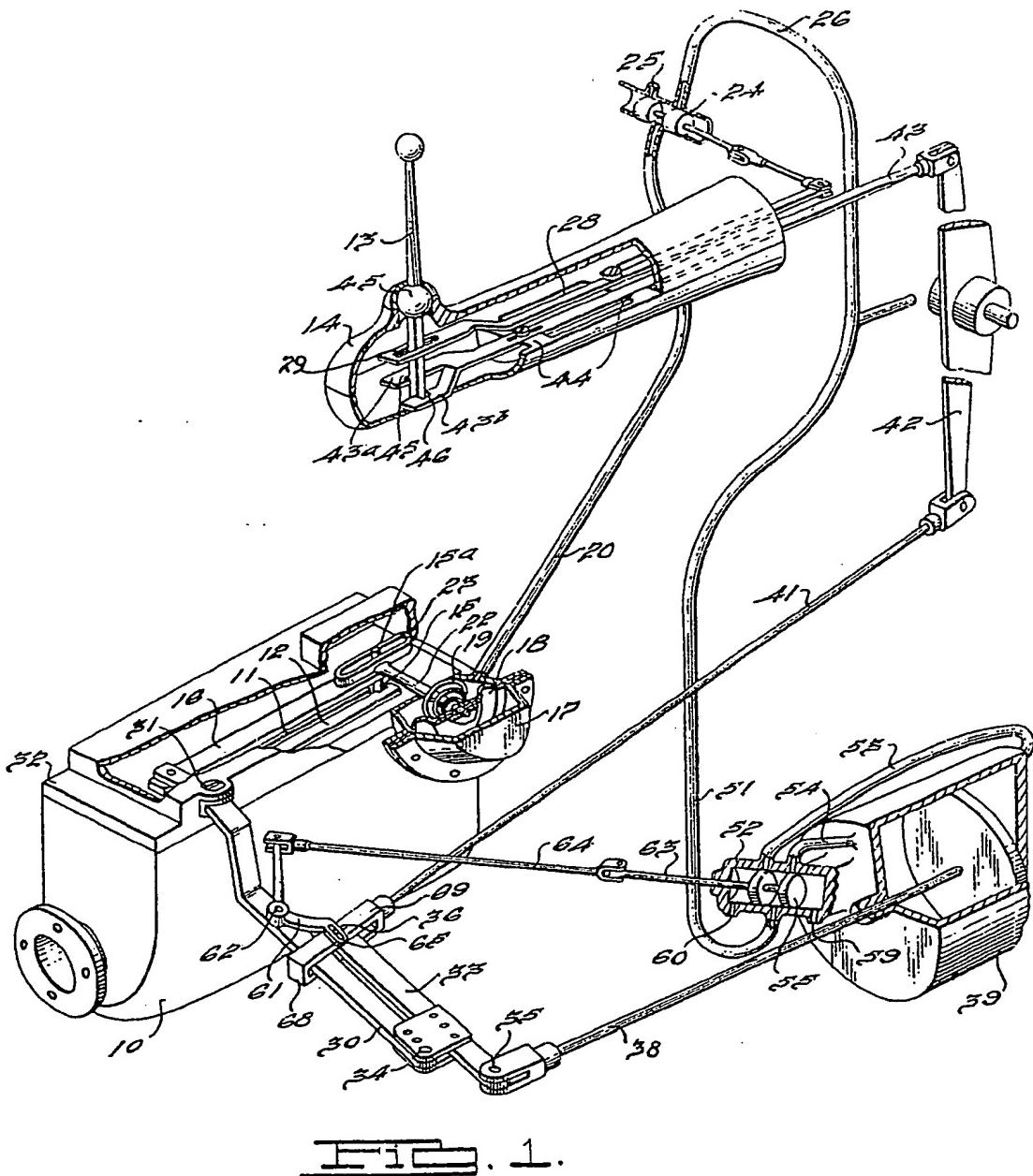
6. Gear shifting mechanism according 105 to any of claims 2—5 in which one of the valve members is fixed to the cylinder of the servo-motor and the other movable member is connected to the transmission operating lever.

7. Gear shifting mechanism according 110 to claim 6 in which the joint connections of the transmission operating lever, the servo-motor piston, the manual control member, and the valve member with the floating device are all spaced from each other.

8. The gear shifting mechanisms herein-described and shown in the accompanying drawings.

Dated this 12th day of August, 1938.
DICKER, POLLAK, MERCER,
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Agents for the Applicants.

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SHEET 1

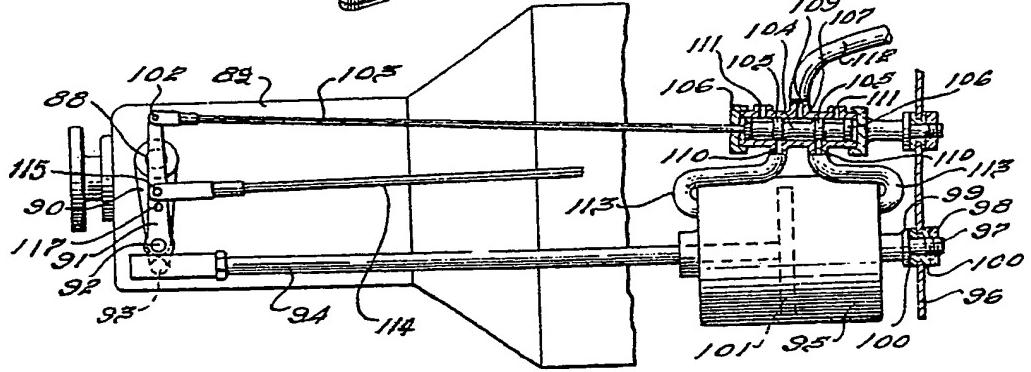
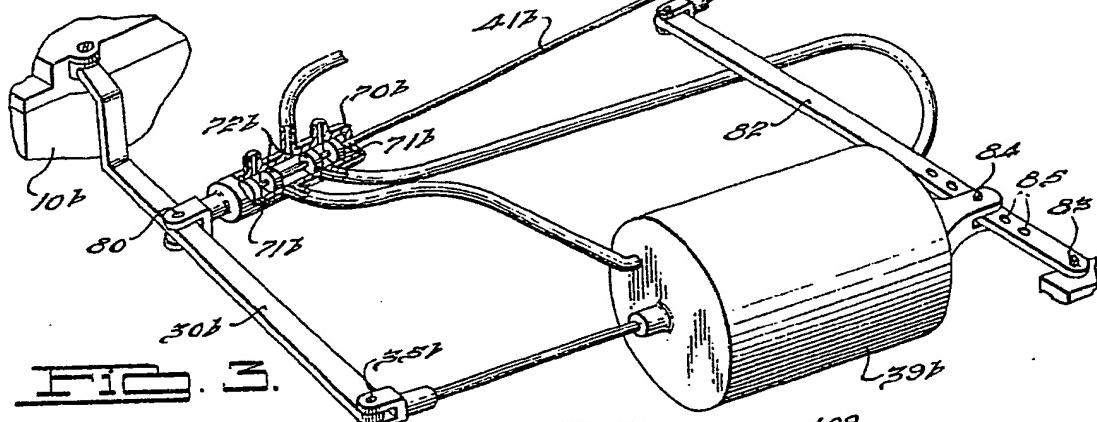
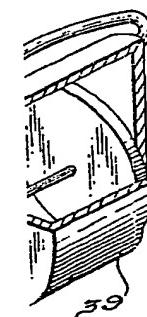
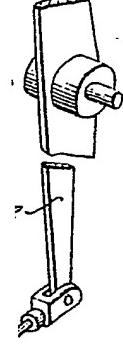
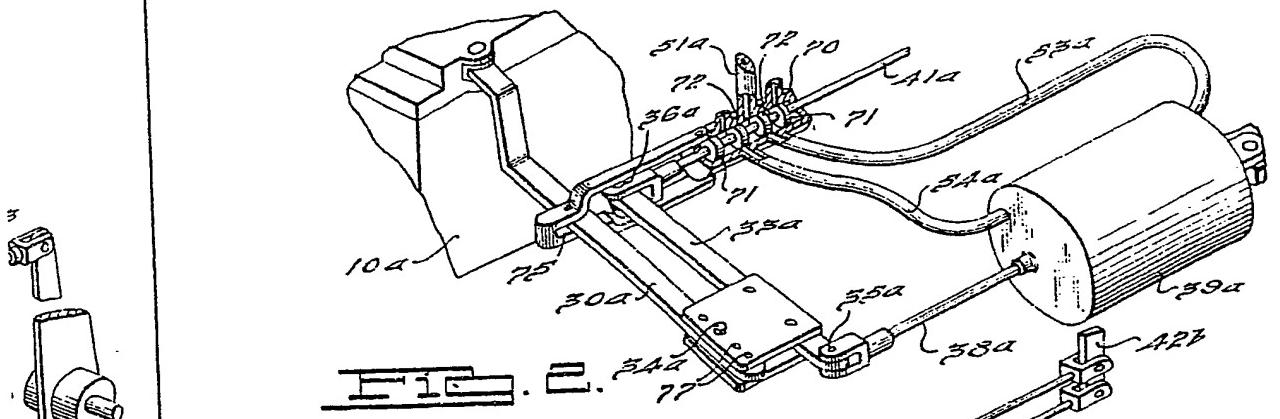
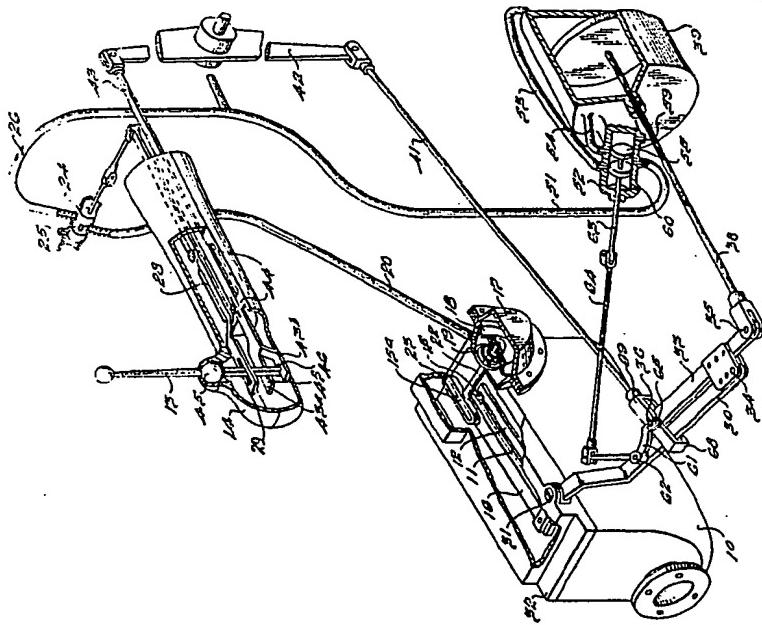


Fig. 4.

517979 COMPLETE SPECIFICATION

SHEET 1



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2 SHEETS

3 SHEET 2

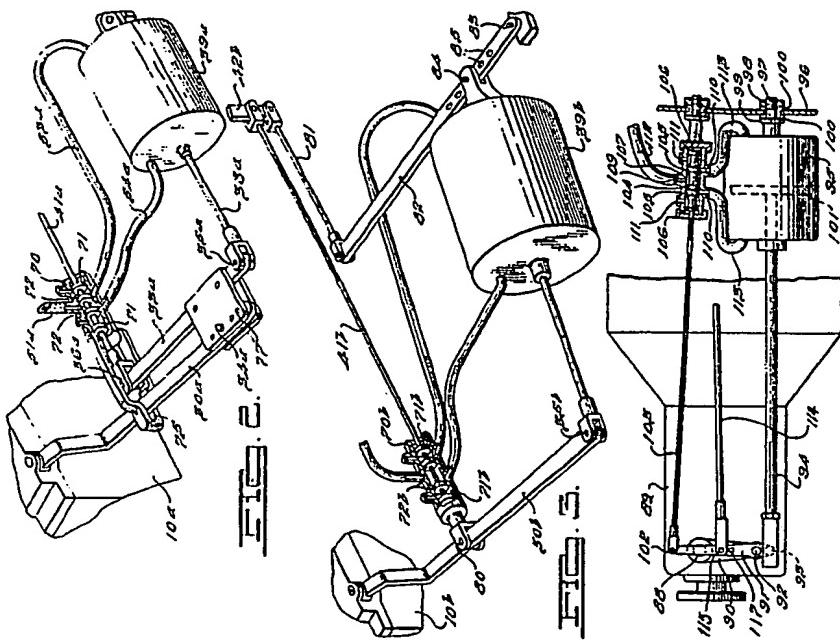


FIG. 4.

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